

# **Brownell Patent Application**

## **METAL CONTAINER AND METHOD FOR THE MANUFACTURE THEREOF.**

### **Background of the Invention**

#### **1. Field of the Invention**

This invention concerns a new container construction and the process and apparatus for its manufacture. The invention provides for better metal utilization resulting in significantly less metal usage and weight. The lighter metal weight is achieved by a unique can body design, the use of a separate, stabilizing base attached to the can body as well as the method of forming the unique can design and the means to attach such a device to the new metal container of this invention. This invention further includes the use of recycled materials in its practice.

#### **2. Description of the Prior Art**

Currently commercial metal containers include a bottom design that is complex and comparatively difficult to manufacture. These current bottom designs include three primary functions: (1) to provide a consistent, flat and strong surface that enables the container to stand upright for handling during manufacture, filling, capping and end use; (2) to provide for reliably and easily stacking one upon another; and (3) to provide a dome shape that will not change under pressure and thereby affect the ability of the can to stack or stand.

The problem that arises from this complex dome design is that if either the metal thickness of the can or the diameter of the seamed-on end changes, the dome design usually must change. This involves extensive engineering, testing and tooling changes that are costly and time consuming.

In practice, the majority of the metal beverage container cost is for the metal used to make the body and the attached closing end. Under present commercial design and manufacturing processes the sidewalls of the container are thinned down to minimum design thicknesses on the order of 0.0038 to 0.0042 inches; however, the can body bottom remains at the thickness of the original body stock, usually on the order of 0.0102 to 0.0106 inches.

Currently metal can bodies for beverage containers are manufactured by either the draw-redraw process (DRD), draw thin redraw (DTR) process or the draw and iron (D&I) process. The most common (D&I) process involves the following steps for example: 1) A circular blank with a diameter on the order of 5.5 to 5.6 inches is cut from sheet stock about 0.0104" thick and drawn into a shallow cup of about 3.5 to 3.6 inches diameter and

sidewalls 1.25 to 1.75 inch high, wherein the walls and bottom are the same 0.0104" thickness of metal; 2) the cup is fed into a bodymaker and re-drawn at least once to form a cup of 2 and 11/16 inch diameter and 2.0 to 2.5 inches high, 3) the sidewalls of the can are ironed nominally three times to get them to their optimum minimum thickness of about 0.0040" and height of about 4.25 inches; 4) the bottom or endwall is reshaped by being redrawn and domed to provide pressure resistance; and 5) sequentially the can body is trimmed, necked, flanged, finished to the specified size and decorated as required. See US Patent 4,148,208 for further details.

From the foregoing examples it will be understood by those skilled in the art that while the sidewall thicknesses are reduced significantly, the can endwall remains at essentially the same thickness as the original can stock and that this thickness is over two times heavier than the sidewall. Prior efforts to overcome this limitation and reduce can weight have included using lighter can stock and allowing the bottom to flex outwardly as shown in US Patents 4,175,670 and 4,417,667. In each of the foregoing flexible bottom constructions, stability of the can was achieved by the addition of outward protrusions from the can body bottom that, when the can was put under pressure, acted as feet on which the can could rest. These cans would not stack, they lost their ability to stand when dropped and it was found that generally the feet created significant stability and other problems in use and with can filling and handling machines so that they proved commercially unacceptable.

The use of what are called "basecups" to enable hemispherical bottomed plastic containers to stand upright is well known from commercial two liter bottles in widespread use today however to our knowledge a separate base has not been used on a generally flat bottomed can.

There thus remains a longfelt unmet need for a very cost effective, lightweight, stable, easily handled, high strength, and widely adaptable, recyclable and attractive can.

## **SUMMARY OF THE INVENTION**

In view of the foregoing disadvantages inherent in the known types of can constructions and methods of manufacture now present in the prior art, the present invention provides a container construction and manufacturing processes that fully meet the above longfelt needs by providing a very cost effective, lightweight, stable, easily handled, high strength, widely adaptable, recyclable and attractive can and method of manufacturing the can.

Containers according to this invention include a body of generally uniformly thin metal and an attached separate base with a footprint generally equal to the diameter of the container. The container has no bottom dome as is known in conventional can

constructions but rather has a generally flat bottom integral with the sidewall through a generally inverted frustroconical shaped transition section having a circumferential concave groove-like formation therein. The bottom may flex when the can is under pressure and such flexure is controlled and minimized by the groove-like formation. The base, of either metal or plastic provides improved conveying, stacking, and transportation features that will be appreciated by those skilled in the art of container design and manufacture.

This invention differs from the conventional DRD, DTR and D & I processes, in that it does not require the construction of a concave dome to contain the pressure of the beverage can, but rather produces a can, which has a relatively flat bottom. This bottom is designed so that after the cupping and drawing operation, a concave formation in the form of a circumferential bead or grove is formed into a transition section of the side wall adjacent to the bottom to provide strength to resist bottom bulging under pressure and to permit the snap-on attachment of a separate base, thereby creating a can that is lighter in weight and easier to produce than the comparable container made by the conventional DRD, DTR or D&I processes. Said process is preferably performed just prior to flanging, but can be performed during or after flanging.

By means of the invention herein the can bottom typically will be of a thickness on the order of that of current can body walls, nominally 0.0045" to 0.0055", which will result in metal usage on the order of 15 to 18 lbs/1000 cans produced, when said material is aluminum. By comparison, a conventional drawn and wall ironed can made from aluminum typically utilizes about 24lbs/1000 cans. Hence the container of this invention uses about 25 to 38% less metal than the conventional can making process.

The primary advantages of this invention over conventional constructions and methods include:

- (a) elimination of metal and still achieve the same can performance and volume;
- (b) savings in the tools to make the container (since the doming operation is no longer necessary and the number of steps in the formation of the can is reduced);
- (c) simplification of the method e.g. the wall-ironing step is replaced by a draw-redraw step, or the wall-ironing step may be simplified to only one wall-ironing ring, instead of the conventional three rings;
- (d) improved ease of washing for removal of manufacturing lubricants and placement of wash coatings, reducing associated costs, because of simpler contour configuration that avoid areas where material can be trapped or pooled;
- (e) improved ease of application of inside lacquers and finishes on the can base, reducing associated costs, because the spray head design is simpler, less lacquer material is required, and simplified equipment costs less.
- (f) elimination of the requirement for the application of a bottom coating to enhance conveyance mobility at the filling operation.
- (g) increased variety of possible materials from which the invention may be manufactured including aluminum, steel, composite materials, or special alloys, especially special aluminum alloys such as Uniloy, reducing costs over and above the

material cost savings due to light weighting and ability to use the most cost effective materials;

(h) reduction in spoilage due to the simplified manufacturing process and fewer process related problems known to those skilled in the art of drawn and wall-ironed cans and draw-redraw made cans; and

(i) reduction in tooling and machine costs and maintenance since a single manufacturing equipment line, tooled with appropriate change parts, may be used to process any of the materials determined to be effective in the practice of this invention.

The base of this invention may be fabricated from plastic (especially recycled plastic, especially recycled PET or HDPE) or from aluminum, which may be recycled and/or not of the quality for can body coil or end stock, or from steel, meeting similar requirements. The means of attachment for one embodiment of the base primarily utilizes the snap fit features on the base cup and the can bottom, and/or gluing of the base cup onto the can bottom. The features are formed when the can body bottom is being formed and when the plastic base is being molded or thermoformed, or if the base is metal, when it is molded or hydroformed.

Cans according to this invention incorporate system improvements and features which produce an attractive and cost effective container including:

1. Improved dimensional stability, and controlled dome growth.
2. Better stackability due to a broader footprint of the base on the bottom and the end chime on the top for stacking.
3. Improved dent resistance and greater drop impact values before end buckling or other damage occurs due to can weaknesses.
4. Ability to stack cans having ends of the same end diameter, but different top end configurations, such as opening features, strengthening ribs, tab designs, and the like.
5. Ability to stack cans which have different top end diameters in the same stack.
6. If seamed on top closure end has a diameter change; the base cup need not be changed to allow stacking with cans of different diameter end closures.
7. Coloring the base so that it is coordinated with the decoration.
8. Coloring the base so that a family of products are color distinguished when displayed, or in storage to avoid strangeware, or in transportation to avoid quality errors.
9. Using the snap on feature of the base with a tamper-evident feature for product promotion, promotion prize or coupon attachment, and the like.
10. Higher stacks of finished goods on pallets, permitted by the additional stability of the can-stacking feature, which can approach that of incoming can stacks.
11. Reduced corrugated or other finished goods packaging.
12. Avoidance of ring stain, due to scuffing of bottom basecoat, and/or reduction or elimination of bottom basecoat related to this problem.

13. Changes to the base profile for non-structural reasons without changing the can bottom profile.
14. Use of conventional can making equipment in the practice of this invention, without the need for recapitalization or special equipment.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

The inventions herein will be better understood and the objects, including the above, and others in addition to those set forth above, will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

**FIG. 1** is a schematic cross sectional view of a vertically oriented empty container according to the invention including the container body and an attached first embodiment of the base shown stacked on another empty container;

**FIG. 2** is a schematic cross sectional view of a bottom portion of a container body with a base attached according to a first embodiment of the invention;

**FIG. 3** is a schematic cross sectional view of the bottom portion of a container body per se according to the invention showing the circumferential strengthening formation before the base has been added;

**FIG. 4** is a schematic cross sectional view of a container base per se as manufactured according to the first embodiment of the invention wherein the base has inwardly directed protrusions adapted to engage the circumferential strengthening formation on the body;

**FIG. 5** is a schematic cross sectional view of a second embodiment of a container base in place on a container body bottom according to the invention herein; and,

**FIG. 6** is a schematic cross sectional view of a base as it appears in the manufacturing process before the circumferential strengthening formation has been added and a schematic representation of the tooling that may be used to make the circumferential strengthening formation in the container body transition portion according to the invention herein.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The drawings illustrate a lightweight container of the invention generally indicated at 10 comprising a generally cylindrical metal body generally indicated at 11 made of generally uniformly very thin metal throughout and having attached thereto a generally circular base of the first and second embodiments 100 or 200 respectively.

As shown in Figures 1 and 2, the container body 11 comprises generally cylindrical sidewalls 12 terminating at an upper free edge 12a defining an open end 13, which free edge 12a may be necked and have applied thereto a closure end not shown after filling as is well known in the art. The other or lower end 12b of cylindrical sidewall 12 merges with an upper end 20a of an angularly related transition section 20 at a lower end first juncture point 15 and in turn the lower end 20b of transition section 20 merges with an outer periphery 30a of a generally flat bottom 30 at a second generally circular juncture point 25 to form the body 10 that will, with an end closure as is well known in the art and not shown in place, hold liquids and other contents under pressure. Bottom panel 30 has an upper side 30b and a lower side 30c. The container body 11 has an outer diameter D1 at said first juncture point 15; a diameter D2 at said second juncture point 25; and an outer diameter D3 at the inside of the formation 40.

The bottom panel 30, oriented generally in a plane that is generally perpendicular to an axis 14 of container body 11, will flex and bulge in the presence of internal can pressure however the amount of flex and bulge is controlled and minimized by the addition of a circumferential strengthening formation 40 in the generally inverted frustoconical shaped transition section 20 as shown in Figures 1, 2, 3, 5, and 6. This formation 40 preferably takes the form, in can making parlance, of a circumferential groove or bead 40 that also lies in a plane generally perpendicular to the axis 14. The reinforcing groove or bead acts as a hoop to prevent or control flexing and bulging movement of the transition section 20 and bottom 30. Depending upon the specific materials and their specifications, bulging of the bottom panel 30 it may be accommodated by a designed predetermined space 35 between the lower surface 30c of bottom 30 and the upper surface 132 of base 100 or the space may vary to substantially zero.

The formation 40 is concave preferably with the following dimensions for a container in the form of a 12 ounce can of 2 11/16 diameter and made for example of H19 3104 aluminum and the like, 0.0045" thick; radius 42 may be in the order of 0.030" to 0.150"; depth 44 will be slightly less than or equal to the radius 42; length 21 of transition section 20 from 20a to 20b preferably is in the order of 0.050" to 0.100"; radii 23 will be created when 42 is generated and depend upon radius 42 and length 20a to 20b; the angle  $\theta$  between the surface of the transition section 20 and the surface of the sidewall portion 10 is preferably in the order of 30 to 45 degrees however 60 degrees may be possible.

While certain dimensions and geometry have been set forth above for the generally given conditions it is to be understood that they are affected by and subject to many variables

such as the container material composition, hardness, temper, angles of inclination, manufacturing processes, coating characteristics etc.

From the foregoing it will be appreciated by those skilled in the can making art that the invention herein utilizes conventional manufacturing machines and processes, but in a new simpler, less costly way to produce a less expensive, more durable can. For example, (a) the very complex doming and end reforming step is eliminated; and (b) either the wall ironing step may be replaced with a draw-redraw step or the typical three stage, three ring wall ironing step may be replaced with a single stage one ring step. Such simplification clearly reduces capital costs and maintenance requirements as well as the opportunity for spoilage. In addition, the simpler can configuration without the dome (c) simplifies washing for the removal of manufacturing lubricants and (d) makes it easier to apply inside lacquers and finishes. A further important advantage is that the simplified processes make it easier to change metals from aluminum to steel to special alloys to composites such as Uniloy material.

In manufacture of the can body 11, the circular starting blank with a diameter of 6.5" to 7.0" is drawn into a first cup of 4.5" to 5.0" diameter and 1.75" to 2.0" high and in turn that cup is redrawn into a second cup having a diameter of 2 11/16 inches and height of 3.0" to 3.5". A single ironing operation extends the can height to 4.80" to 5.10". The trimming and necking/flanging operations on the upper free end 12a are substantially the same as with conventional cans as shown in the prior art.

The method and apparatus for manufacture of the circumferential formation 40 is schematically illustrated in Figure 6 where there may be seen a can body 11 having the bottom 30 supported on a base pad 300. The base pad 300 has a recess 310 of a diameter 320 and a surrounding circular lip 330 of a diameter D4 equal to the outside can diameter D1 and an angle generally matching the angle  $\theta$  of the transition section 20 whereby the can body 11 is centered and held against lateral movement.

A temporary end closure not shown but known by those in the art seals the open end 13 of the can body 11 and introduces air under pressure to rigidify the can. The base pad 300 axially forces the can open end 13 against the unshown end closure and the whole pressurized can body 11, base pad 300 and closure assembly rotates about the axis 14 of the can body 11. During rotation a rotating disc assembly 350 is moved or plunged toward the can axis 14 and is brought to bear against the transition section 20 to roll-form the groove-like formation 40 circumferentially around the can and then removed. The rotating disc 350 is of a predetermined diameter, thickness and edge curvature 355 to efficiently create the formation 40. In practice the radius of the edge curvature 355 may be compound with a top portion in the neighborhood of 0.045" for example and a lower radius in the range of 0.070" for example. In this example, the smaller 0.045" radius does the digging and the 0.075" allows the "metal wave" to flow ahead and around the tool. Of course it will be understood that experimentation will be required for the various material and process parameters. This roll forming operation may advantageously be effected after or during the die necking operation. Depending on the characteristics of

the metal being used, the working of the metal may result in a work hardening or coining that will produce a serendipitous increase in strength in the can bottom and/or the portion 20.

As shown in Figure 4, the base 100 is a generally disc-like structure having an upstanding, generally circularly shaped bottom-receiving rim 110 with an inside surface 120 that is of a size and shape to closely mate with the outer surface 20c of transition section 20 when the base 100 is attached to the body 11 as shown in Figures 1 and 2. The surface 120 includes a convex projection or lug 140 that is shaped and positioned to mate with the concave formation 40 when the base 100 is attached to the body 11. The mating surfaces not only effect a grip locking the base 100 to the body 11, but also synergistically greatly reinforces the formation 40 and helps control the bulge of the body bottom 30. In position surrounding the transition section 20 and bottom 30, the base 100 provides very significant protection for the damage prone transition section and can body bottom 30 against dents, dings and other damage that could cause leaks. To increase the grip of the base 100 on transition section 20 and projection 140 in formation 40 the base is manufactured to have the configuration shown in solid lines in Fig. 4 whereas when attached to the body 11 it will have the configuration as shown in dotted lines in that figure. Of course the base may be designed with appropriate tolerances to match the manufacturing tolerances of the can body.

A lower generally annular ring-shaped surface 150 of base 100 is circular and lies generally in a plane. The surface 150 has a relatively wide width 152 that serves as a superior support surface for the container 10 to keep it upright and very stable. The larger "footprint" or diameter of the base 100 over current commercial cans constructions and larger support surface 150 greatly improves stability during conveyance in manufacture, filling and use and also improves stackability of one can upon another. With the diameter D4 of the surface 150 generally equal to the diameter D1 of the body 11 the stability is for all practical purposes at its maximum. Inside the ring-shaped surface 150 is a stacking cavity 154 having a diameter 156 that allows nesting of the upper end of containers therein and is large enough to permit stacking of a range of end closure diameters equal to the largest diameter upon which the container 10 is expected to be stacked. Under current complex commercial designs any change in the can closure ends, as for example to effect metal savings, requires an expensive and complex change in the bottom design to allow stacking hence the invention provides a significant benefit.

Inside the upstanding structure 110 and support ring 150 there may be provided a generally planar panel 130 having a generally circular upper surface 132 and a generally circular lower surface 133. Upper surface 132 may be designed to be spaced from a lower surface 30c of body bottom 30 a predetermined distance 38 to allow the bottom 30 to flex outwardly when the can is pressurized. It will be understood that the space 38, if any, will depend upon the material, its thickness, the designed internal pressures, etc. It has been observed that when the lower surface 30c of can body bottom 30 flexes into



contact with the upper surface 132 it rotates the rim 110 inwardly against the can thereby increasing the pressure of the projection 140 into the formation 40.

Although the panel 130 is shown as extending fully across the bottom, it is within the contemplation of this invention that the panel 130 could be partially or fully removed or removable to permit more bottom bulge in certain circumstances. An advantage of the panel 130 is that it permits concealment of indicia useful for contests or promotions on the underside of the can bottom 30c or the upper surface 132 of the panel and hence the panel may be made removable as well whereby purchasers may for example break out a prescored portion to determine whether they have won.

In a second embodiment as shown in Fig. 5, a base 200 is of the same construction as the first embodiment except it does not include the projection or lug 140, but instead relies solely upon adhesives to hold it onto the body 10. Also useful to the practice of the invention may be the inclusion of reinforcing ribs or other structures to reinforce the bottom and to hold the base to the body.

The base of the invention may be fabricated from plastic material such as the relatively inexpensive recycled PET or HDPE in a conventional molding process such as injection or thermoforming. The base may also be made from recycled or lower quality aluminum by conventional aluminum forming processes such as molding or hydroforming. It is a further advantage that the base may be color coordinated to the colors on the label on the container.

Since the base may be plastic, the process of bottom coating the outside of the can body in the can manufacturing process may be eliminated to save time and money. Thus, it has been found that after going through many conveyance areas in manufacture, filling and use, the outer coating on the aluminum can may be worn off so that it is susceptible to leaks at worst or leaving a ring or stain at best. The plastic base overcomes these disadvantages. Also, because of the larger footprint and wider base 152 the cookie cutter effect on the cardboard packaging when stacked and stored is greatly reduced or eliminated.

The manner, method and apparatus for attachment of the base 100 or 200 to the body 11 will depend upon the geometry of the specific body and unattached base. As shown schematically the upper portion of the ring-like structure 110 of base 100 will be guided by the form 40 and transition section 20 during a straight "snap-on" attachment. In the case of base 200 and possibly base 100 in certain instances, it will be understood that appropriate adhesives as known to those skilled in the art may be applied between the body and base at appropriate places such as around the transition section 20 and at the bottom

The schematic drawings purposely illustrate variations in dimensions for portions having the same reference number to show possible variations in those dimensions.